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METHYL BROMIDE SOLUTION STUDIES: COLLAR TREATMENTS FOR NURSERY STOCK

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INTRODUCTION

Since April 1940 the laboratory for tests of treatments for the Japanese Beetle has been engaged in field studies with methyl bromide solutions in an effort to develop treatments for use in the administration of the Japanese beetle quarantine. Until the autumn of 1941 the work was concerned with solutions of methyl bromide, alcohol, and water prepared in an open drum with more or less stirring. The procedure, with various modifications, was patterned after that developed by Livingstone, Easter, and Swank (2) and used in quarantine treatments for the white-fringed beetle (3). Data were accumulated on treatments effective against Japanese beetle grubs in turf, in heeling-in areas for nursery stock, in field beds of potted plants, and for areas enclosed by metal collars suitable for use in treating the soil about individual items of nursery stock in field rows.

In September 1941 the laboratory cooperated with R. D. Chisholm and L. Koblitsky, of the Division of Insecticide Investigations, at Moorestown, N. J., in a study involving methods for the preparation of methyl bromide solutions. A summary by Chisholm and Koblitsky (1) of the data obtained from these studies is the subject of a separate paper.

In brief, the data indicated that solutions of methyl bromide and water, either with or without alcohol dissolved in the water, could be prepared in a closed system under head pressure, from the initially volatilized methyl bromide, at substantially less cost and with better standardization of solution strength than was possible with the open system of preparation previously used. Loss of methyl bromide from the open system occurred at every step of preparation and was critically affected by water temperature. There was no opportunity for loss during closed-system preparation, and

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1/ In cooperation with the Division of Japanese Beetle Control. The writer is especially indebted to George F. Kerbey and E. Howard Phillips for assistance in the work discussed.

about 90 percent of the methyl bromide entered into solution regardless of water temperature. Frequently the loss of methyl bromide from open-system solutions is believed to have exceeded 50 percent by the time of withdrawal for use. Although pressure is required during preparation of closed-system solutions, this can be released after preparation with little subsequent reduction in concentration during the interval of time necessary to apply treatments.

These findings, while largely preliminary, were promising enough to demonstrate the value of their application in field-mortality tests during the autumn of 1941. Owing to the season's unprecedented drought, the field studies were considerably restricted. The information obtained is promising and has indicated the advisability of basing most of the laboratory's future studies on closed-system solutions.

MATERIALS AND METHODS

Closed-system apparatus: The vessel used in field studies is an 82-gallon, reinforced, export-type steel drum provided with a bushing welded in the head, in which is installed a water spigot with threaded outlet. With the drum on its side, bung up, the spigot is at the lower edge of the barrel. An 18-inch length of garden hose attached to the spigot reaches to the bottom of the sprinkling can used in withdrawing solution for use.

For treatments involving an original stock solution of methyl bromide and alcohol, a mixing chamber was devised which releases liquid through the bung cap into a tube which extends to within 1 inch of the bottom of the drum. This chamber consists of a graduated glass tube of 1,100 cc. capacity, which is capped with a brass cover, through which 1 pound of methyl bromide is released into a tube discharging at the bottom of the chamber, and which is provided with a bung and removable plug for the introduction of alcohol and a valve for the adjustment of pressure during the introduction of the methyl bromide. Through an orifice in the brass base plate the stock under valve control is withdrawn into the tube which passes through the bung cap of the drum. In work to date, if methyl bromide alone is to be used, a standard applicator is attached to a tee in the line just above the valve, and the required charge is released into the same tube.

With the desired quantity of water in the drum and all thread fittings rubbed with brown laundry soap to insure an easily broken but airtight seal, the bung cap is set down tight on a rubber gasket, and the required charge of stock or of methyl bromide alone is introduced. The drum is gently rocked back and forth for 5 minutes to facilitate formation of the solution. The cap seal is then broken and the solution is ready for use. Solutions are withdrawn into garden sprinkling cans of the desired size and are applied therefrom by pouring over the edge as quickly as possible.

Closed-system studies to date have been limited to treatments designed for nursery stock and have involved units of 1/3-square-yard surface area enclosed by circular metal collars set into the soil surface just enough to prevent run-off.

Certain procedures in collar treating and subsequent digging have been indicated as advisable, based on experience with open-system tests. Soil surfaces within collar areas must be somewhat mulched and practically free from weeds and grass. After dosage application, the soil surface must be leveled by hand (rubber gloves being worn), with as little agitation of the liquid as possible, to insure complete surface coverage, at least of those dosages applied at the rate of 1 gallon per 1/3-square-yard collar. This necessitates a loose surface soil. For dosage above 1 gallon per collar, complete coverage usually occurs with the soil smoothed prior to treatment. Surface vegetation impedes leveling and breaks up the solution stream at application. This in turn is believed to result in increased escape of methyl bromide before penetration into the soil. Collar areas are dug approximately 24 hours after treatment (20 hours minimum) and for convenience are held in open 1/2-bushel produce hampers for at least 4 days before the initial examination for mortality. This insures inclusion of the post-treatment toxic action in evaluating mortality results.

RESULTS

The data on closed-system solution treatments obtained in the autumn of 1941 are shown in table 1. Except as indicated, the solutions were prepared by adding 1 part of methyl bromide to 2 parts of commercial ethyl alcohol in the mixing chamber and introducing this stock into the water in the drum. Various quantities of water were used in solution preparation. This may have introduced an error in the concentrations presumably obtained which will require future adjustment. The percentage concentration of methyl bromide is on a volumetric basis. This is used in preference to an expression of percentage by weight, inasmuch as it has been employed by other workers in earlier publications. The percentages listed are based on assumed complete solubility of the methyl bromide, whereas about 90 percent solubility is a more accurate figure. In any event, this is believed to be a relatively constant amount. The records are exclusively for Japanese beetle larvae.

Table 1.--Summary of closed-system collar treatments, 1941. All records are for 1/3-square-yard collars, with dosages as shown.

CH_3Br concentration	Dosage: per collar	Soil temperature: Surface	2 in.	6 in.	Solution temperature	Number of collars	Total number of grubs	Mortality	Comments
Percent	Gallons	°F.	°F.	°F.	°F.			Percent	
0.075	1	65	65	65	62	10	112	100.0	
	1	75	70	61	61	15	432	100.0	
	1	60	59	60	60	15	389	100.0	No alcohol
0.050	1	65	65	65	62	8	81	100.0	
	1	69	69	71	61	15	545	100.0	
0.0475	1	57	57	59	61	15	432	97.9 1/	No alcohol
0.039	1	48	46	43	52	10	639	59.8	
	1 1/2	48	46	43	52	8	328	72.3	
0.025	1	65	65	65	62	8	60	95.0	
	1	75	70	61	61	15	463	100.0	
	1	57	57	60	60	15	390	95.4 1/	No alcohol
0.022	1	43	40	43	53	8	398	35.9	
	1 1/2	43	40	43	53	8	481	50.3	
	2	43	40	43	53	10	490	66.8	
						160	5,240		

1/ Field mortality at examination. Judging from the behavior of the larvae, mortality would have been somewhat greater if provision had been made for holding grubs for subsequent examinations

DISCUSSION

The data shown are insufficient basis for the adoption of closed-system solutions as a means for obtaining quarantine certification of nursery stock to be moved out of the area under the quarantine against the Japanese beetle. They demonstrate, however, that such solutions are effective in exceedingly low concentrations when used as described above. The three records involving solutions of methyl bromide and water without alcohol compare favorably with similar ones in which the methyl bromide-alcohol stock was used.

With methyl bromide at 70 cents per pound, the cost of material for treating with a 0.075-percent solution amounts to about 0.76 of a cent per 1/3-square-yard collar, with lower concentrations at proportionately lower cost. On a larger scale, the cost of material for a 0.075-percent solution amounts to about $37.25 per acre. This makes no allowance for labor and is purely speculative, since no means for application on an acre basis have been devised.

REFERENCES CITED

(1) Chisholm, R. D., and Koblitsky, L. 1942. A chemical study of the preparation and stability of aqueous methyl bromide solutions. Bur. Ent. and Plant Quar., E-575, 8 pp.

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(3) U. S. Dept. Agr. March 15, 1940. Administrative instructions -- Modifying the restrictions of the white-fringed beetle quarantine by authorizing treatment by methyl bromide solution of balled nursery stock of specified thickness B. E. P. Q. 503 Revised, 2 pp.

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